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UNIVERSITY OF ALBERTA

COGNITIVE STYLE AND COMPETENCY BASED APPRENTICESHIP TRAINING

BY

BRIAN T. FLANAGAN ©

A thesis submitted to the Faculty of Graduate Studies and Research in partial fulfillment of the requirements for the degree of Master of Education.

IN

ADULT AND HIGHER EDUCATION

DEPARTMENT OF ADULT, CAREER, AND TECHNOLOGY EDUCATION

EDMONTON, ALBERTA

FALL 1994

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The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research for acceptance, a thesis entitled COGNITIVE STYLE AND COMPETENCY BASED APPRENTICESHIP TRAINING submitted by BRIAN T. FLANAGAN in partial fulfillment of the requirements for the degree of MASTER OF EDUCATION in ADULT AND HIGHER EDUCATION.

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Dr. D.J. Collett

Dr. W. Brouwer

June 7, 1994

Dedication

This thesis is dedicated to the memory
of my father
Rory Terence Flanagan
whose help and encouragement
is forever appreciated.

Abstract

Trades training in its traditional form, has been with us for a long time. A pilot project has been carried out involving Competency Based Apprenticeship Training (CBAT). CBAT is a form of Competency Based Vocational Education (CBVE) which incorporates both Mastery Learning and Computer Managed Learning. The present research examines the cognitive style of Electrician Apprentices studying under CBAT.

The research into cognitive styles has for the most part avoided any studies involving apprenticeship students, a search of the literature on cognitive style as it relates to apprenticeship students produced few documents. Some work has been done converting traditional trades training to competency based education, but this is also a relatively recent phenomenon.

The present study attempted to determine if a relationship exits between the cognitive style of Field Dependence-Independence and selected variables. The dependent variables chosen for this study were academic success, age, and time to completion. An ex post facto methodology was chosen for this causal-comparative research. Witkin's Group Embedded Figures Test (GEFT) was administered to a complete Second Period Apprentice Electrician class. This class of 58 male Apprentices wrote the GEFT at their NAIT orientation on August 27, 1991. The resulting data and the NAIT and Apprenticeship Board exam results, were analysed twice. A mean split and a median split were both used in analyses of the data because the GEFT manual does not

specify a dividing point. T-tests found that the mean split did not produce significant results, but the median split did for three variables. Field Independent apprenticeship students achieved higher grades on both the NAIT exams and the Apprenticeship Board exams. FI students also tended to complete their studies faster than FD students.

Acknowledgement

This paper would not have been possible
without the constant support
and love provided me by my wife
Patricia and my children Dana, Keltie and Brendan.

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Chapter One

The Problem and Its Setting

Trades training has historically been a process of indentured apprenticeship in which an apprentice or learner joined with a journeyman or master and learned a trade by working alongside this master. As time passed a series of associated classroom activities began to occur in schools for tradesmen and this became known as technical training. This technical training has undergone many changes during its history. One of the most recent changes has been the advent of Competency Based Vocational Education (CBVE). CBVE is premised on Mastery Learning utilizing Computer Managed Learning (CML) which incorporates modularized, self-paced instruction. "Competency Based instruction, which enables students to focus on a high level of achievement of competencies and tasks drawn from the occupations in which training is being provided, specifies what is to be learned with great exactitude. This instruction is known as competency based vocational education" (Knaak, 1977, p. 19). Hirst (1977) calls CBVE "a systematic approach to instruction, aimed at accountability, based on job-derived standards, and supported by a feedback mechanism" (p. 52).

Mastery Learning as defined by Bloom (1968) suggests that mastery be stated in terms of performance objectives, with class instruction supplemented by feedback/correction mechanisms (in Block, 1971). Guskey (1985) agrees and defines mastery learning as an instructional process including "organizing instruction, providing students with regular feedback on their learning progress, giving guidance and direction to help students correct their individual learning difficulties, and providing extra challenges for students who have mastered the material" (p. xiii). CBVE includes not only mastery learning but also the notion of individualized instruction (Knaak 1977). Knaak defines this as "instruction for individual students on a self-paced basis with variable amounts of direct instructor assistance" (p. 13). Competency Based Vocational Education is concisely summarized in a manual developed by the Florida Department of Education (1976). CBVE is defined as relying on the following assumptions:

1. The skills and knowledge that students learn should be directly related to the duties and responsibilities they will have to perform on the job.

2. These skills and areas of knowledge, and the means for evaluating their attainment, should be specified in advance and made known to the student.

3. Students should be provided with whatever instructional experiences they need to attain the skills and knowledge required by the jobs they are aiming for (p. 1).

The manual also emphasizes the need for a competency-based approach to include individualized instruction. These two concepts of learning for mastery using performance objectives nicely dovetail with a third component called Computer Managed Learning, also known as Computer Managed Instruction. CML is used for test taking and student record keeping. The computer generates random tests from a test bank and then both scores and registers the results of these tests.

It is against this backdrop that the Apprenticeship and Trade Certification Branch of the Alberta Career Development and Employment Department began in 1988 to pilot Competency Based Apprenticeship Training (CBAT). "CBAT is a new approach to the technical training of apprentices which allows each individual to progress through training at a rate determined by his or her own capabilities and work experience" (Alberta Apprenticeship pamphlet, 1993). This approach to education, broadly known as Competency Based Vocational Education (CBVE) has been sufficiently successful to warrant more detailed study and experimentation (Candy & Harris, 1990).

Apprentices with a variety of backgrounds, experiences, interests and abilities attend either traditional technical training or Competency Based Apprenticeship Training (CBAT). To ensure student success, it is essential that any type of educational approach addresses the needs of its learners. Each learner has their own characteristic way of processing information, feeling, and behaving in learning situations (Price, 1983). Since competency based trades training is in the experimental stages in Alberta and student success is desirable, this area is well suited to research. "One promising line of research involves the investigation of the relationships between learning styles and academic success" (Candy & Harris, 1990, p. 38). With this in mind, the intent of the present study was to determine if a relationship exists between cognitive style (learning style) and academic success for a selected group of apprenticeship students studying under CBAT.

Statement of Purpose

Competency Based Vocational Education and cognitive styles cover a broad spectrum of topics and issues that merit attention. This study focused on one aspect of CBVE, namely Competency Based Apprenticeship Training (CBAT) as it was being piloted in Alberta and the cognitive style construct developed by Witkin known as Field Dependence-Independence (FD-I). Bearing this in

mind, the purpose of this study was to find out the cognitive style of the Electrician apprentices and the relationship of this cognitive style to the variables of academic success, age, and time on task. The intent of the present study was to determine if some types of students are put at a disadvantage when studying under CBAT because of a mismatch between their cognitive style and the approach to learning used in CBAT. To this end, research into the whole area of cognitive style and CBAT may help in the future design and planning of technical training programs to meet all students' needs.

The Hypotheses

The purpose of the study is operationalized in terms of four null hypotheses which serve to focus the collection and analysis of data. These hypotheses are stated below:

1. Second period Electrician apprentices enrolled in CBAT show no difference in academic success on the NAIT exams regardless of their cognitive style.

2 Second period Electrician apprentices enrolled in CBAT show no difference in academic success on the Apprenticeship Board exams regardless of their cognitive style.

3. Second period Electrician apprentices enrolled in CBAT are no faster completing their program regardless of their cognitive style.

4. Second period Electrician apprentices enrolled in CBAT have no difference in their age regardless of their cognitive style.

The data analyzed to derive answers to these hypotheses were based on the Group Embedded Figures Test (GEFT), the trades school marks (NAIT), the Apprenticeship Board exam marks, the hours the students spent in the program, and the ages of the students.

Need for the Study

As with any major change in education, the move in post-secondary education towards the competency based model in apprenticeship training presently being piloted in Alberta incorporates some uncertainty. The shift from traditional, group based classroom instruction to modularized, individualized, self-

paced instruction is a major change in the methodology of trades training in Alberta. This is also a relatively recent phenomena in technical training in Canada, although Holland College in P.E.I. has been completely competency-based since 1970 (TAFE Report, 1985). Apprenticeship training in New Zealand has been committed to competency based apprenticeship training since 1982 (Burleigh, 1988).

The recent impetus to better understand cognitive styles and to relate this to an individual student's ability to cope with the curriculum has led to some recent studies relating academic success and cognitive styles. "In the field of education and training, cognitive style is recognized as an important factor to be incorporated into the design of effective training programs" (Rouse and Rouse, 1982, p. 649). Walker, Merryman, and Staszkiewicz (1984), found that by using measures of cognitive style they determined that it was possible to predict mastery in competency based vocational education. The present study attempted to determine if the new teaching method presented in CBAT is better suited to a particular cognitive style. Research indicates that when teaching and learning styles are matched, learning occurs more effectively (Witkin, 1977). Therefore, some students exhibiting a specific cognitive style may be put at a disadvantage studying under CBAT, whereas other students exhibiting a differing cognitive style may be put at an advantage studying under CBAT.

Assumptions

This study is based on the following assumptions:

1. That the available sample of second year Electrician apprentices at NAIT is representative of the larger population of Electrician apprentices in Alberta.

2. That the Group Embedded Figures Test is both a valid and reliable indicator of cognitive style for this group.

Abbreviations and Definitions of Terms

Academic success--was taken to mean the grades in percentages as reported on both the NAIT final exams and the Apprenticeship Board exam.

CBVE--Competency Based Vocational Education.

Cognitive style--the habitual way of processing information that is typical of an individual's mode of perceiving, thinking, problem solving, and remembering (Messick, 1976).

CMI--Computer Managed Instruction-wherein students self-study and self-pace themselves through lesson modules off-line (Baker, 1978).

CRAME--Centre for Research in Applied Measurement and Evaluation at the University of Alberta.

FD-I--Field Dependence-Independence (a measure of cognitive style).

GEFT--Group Embedded Figures Test (Witkin, 1971).

Mastery Learning--an instructional process of organizing instruction, providing students with regular feedback and giving guidance to help students correct their learning difficulties (Guskey, 1985).

NAIT--Northern Alberta Institute of Technology, Edmonton.

Period--the term defining the year of apprenticeship, as in first, second, third or fourth.

Time on task--was taken to mean the total elapsed time measured in hours, taken from the beginning of the course until completion. 6 hours was one full day's attendance.

Delimitations

The study did not attempt to explore any other factors that may affect learning such as intellectual ability, motivation, attitude, reading level, or self-concept.

Limitations

The following limitations of this study may influence the degree to which the results might be generalized to a larger population and are a threat to the external validity of the research.

1. The size of the sample was relatively small. The full expected enrollment of the study group resulted in a sample size of fifty-eight.

2. The accessible sample was not selected at random from the population. The sample was a class formed from the population of eligible second period Electrician apprentices from central and northern Alberta according to the normal selection process used by the Apprenticeship and Trade Certification Division of Alberta Career Development and Employment. It is unlikely that any

systematic bias exists in the data, but this factor was not investigated.

Organization of this Report

The first chapter provides a statement of the problem along with four hypotheses for examination. The significance of the study is described as well as some of the assumptions associated with research of this nature. Also, several terms are identified, abbreviations given, and the limitations and delimitations of the study are identified.

Chapter two contains an examination of the literature related to the problem. The literature review which concentrates on cognitive style and Competency Based Vocational Education does so by examining the following six areas:

1. Causal-Comparative type of research methodology.
2. Traditional trades training.
3. Competency Based Vocational Education.
4. Comparison of Traditional and Competency Based education.
5. Field Dependence-Independence as a cognitive style.

6. The lack of research involving apprentices.

Chapter three focuses on the research methods used in the study. The variables used and the different stages of the research are explained, including sample selection, distribution of the instruments, responses received, and treatment of the data.

Chapter four presents the results of the analyses of the data collected in the study. Comparisons are made between the variables and the two cognitive styles.

Chapter five concludes this report. A summary and discussion of the data analyses is presented. Finally, some conclusions are stated along with recommendations based on the results of this study.

Chapter Two

The Review of the Literature

The review of the literature related to the problem of the current study began with a sampling of the literature on research methodologies. The research method chosen for this study particularly suited the NAIT requirement for non-intervention and hence this researcher deemed an 'ex post facto' methodology best. For this reason, a causal-comparative type of research methodology was chosen.

To establish a background to the present study, a description of traditional trades training was described next. This researcher drew much of this material from his own personal experience, having progressed through the Alberta apprenticeship system in the late 1970s.

Competency Based Vocational Education was then discussed with a particular focus on characteristics of these types of training programs. A comparison between CBVE and traditional trades training was then made.

The cognitive style of Field Dependence-Independence was described with particular attention paid to the characteristics of learners exhibiting this type of cognitive style. FD-I was chosen as

the basis for this research study because "it holds a substantial lead over any other dimension in the extent and quality of research" (Cross, 1976, p. 116). The cognitive style of Field Dependence-Independence was examined with particular attention paid to how this style might impact students' learning.

Finally, this researcher documented the lack of research studies carried out with apprenticeship students.

Causal-Comparative Research Methodology

This researcher has chosen to conduct a causal-comparative type of study. There will be no true experimentation done, phenomena which have already taken place are the basis for this kind of research. Therefore as Leedy (1989) asserts there is "little that is experimental about it" (p. 227). This type of research is also known as ex post facto from the Latin for 'from after the fact' (Ary, Jacobs, & Razavieh, 1990). This researcher did not use a control group as a basis for comparison. There was no intervention other than the administering of the GEFT during the NAIT orientation. This conforms with the NAIT directive to external researchers which states that there will be "no substantial disruption of Institute services, staff, or students" (NAIT Bulletin DB.1, 1988). Therefore, because this research contains no experiment, no

manipulation of independent variables, an ex post facto or causal-comparative type of research was particularly suited to this research problem. This researcher had no "direct control over independent variables...because they have already occurred" (Ary, Jacobs, & Razavieh, 1990, p. 355). Instead, Field Dependent and Field Independent Electrician apprentices studying under CBAT were assessed using the GEFT which took no more than twenty minutes. The other relevant data concerning academic success (exam marks) and time to completion were gathered from NAIT files after the students had completed the course. This 'hands off' approach fulfilled the NAIT requirement that external researchers cause no disruption to students. Conforming to all NAIT requests was of utmost concern to this researcher, so that the research could proceed with the approval of the host institution.

In summary, the descriptive method used in this study had the advantage of being easy to use, it produced data which were both accurate and representative and there was no manipulation common to experimental methods (Merriam & Simpson, 1984). However, the major limitation to this type of study is the inability to determine causation.

Traditional Apprenticeship Trades Training

In Alberta, as in the other provinces of Canada, an apprenticeship training system operates to provide industry with qualified tradespersons. A person wishing to pursue a trades career could approach an employer in the field and apply for a job. Entry level jobs such as labourer and trades helper can then lead to an indentured apprenticeship. Once a formal apprenticeship contract with the employer is signed, the trainee becomes registered in the Alberta Career Development and Employment Apprenticeship system. In this way, training begins under a qualified Journeyman for the duration of the apprenticeship period, lasting anywhere up to 4 years.

In Alberta, the apprenticeship program is jointly supervised by three distinct bodies; 1) the Alberta Government, which administers the program, 2) the various technical training institutes and community colleges, which offer the periodic technical trades training courses, and 3) industry which proposes the requirements for the curriculum and helps to establish the standards. Alberta recognizes 52 trades of which 48 utilize apprenticeship training.

Traditionally, each apprentice progresses through their period of indenture, which ranges up to 4 years, depending on the trade. An apprenticeship consists of on-the-job work experience and in-

school technical theory training. Each trade specifies the number of hours expected to be completed before any formal classroom training may take place. This requirement ranges from 1600-2100 hours. An Electrician apprentice must serve 1800 hours of on-the-job work experience and training under the supervision of a qualified journeyman before being allowed to attend an institution's technical training program. When an Electrician apprentice attends school, it is for a period of eight weeks at a recognized technical training institute. There are only two criteria for success at the end of each period of technical training. One is to pass the institute's final exams and the other is to pass the provincial trades exam administered by Alberta Career Development and Employment.

The current state of trades training in Alberta has generally followed the traditional approach to education. The students all entered the program at the same time, this is called fixed entry. The students then all proceeded through their program of instruction together for a definite period of time, usually 6 to 8 weeks, depending on the trade. The students then all wrote their final exams together and exited the program at the same, this is called fixed exit.

In the formal classes, information was usually delivered via lectures, demonstrations, and simulations with a certain amount of hands-on laboratory experimentation. Instruction and learning time would be the same for all students unless there were a

reading assignment, which students may perform outside of class and at their own pace. There is usually a pre-determined pass mark for all exams. On the last day of classes a provincial Apprenticeship Certification examination is administered by a representative from Apprenticeship Alberta. These exams are then removed from the training institute and marked in a central location with the final results being made available some 4 to 6 weeks later. The pass mark on these exams is usually 65%. Apprentices who marginally fail this exam are eligible to write a supplementary exam, within three months. If they fail this second attempt, they must then repeat the period of technical theory training.

In this type of education, the learners adapt to the constraints of the curriculum and institution, with no control over the pace or order of instruction and without control over the time spent on technical training. The common elements to this type of training are a fixed entry time, a fixed time to learn the materials, and a fixed exit time. Until 1988, all technical training institutes in Alberta which offered Electrical trades training did so in the traditional format. There are now two exceptions to this, both NAIT and Lethbridge Community College are piloting the CBAT approach to Electrical trades training. Red Deer College is commencing the CBAT approach to Electrical trades training beginning in September 1994.

Competency Based Vocational Education

The concept of competency based vocational education (CBVE) has had a great impact on educators and on society (Knaak, 1977). Blank (1980) is one of the strongest proponents of CBVE listing what he calls "common sense" reasons for its use. This includes allowing each student to achieve mastery of one competency before moving on to the next, thus helping to reduce failures, absenteeism, and other behaviour problems. He believes CBVE shortens training time for some students and it meets the needs of special learners. Finally, Blank (1980) says that CBVE allows institutions to offer open-entry, open-exit, self-paced programs. Moss (1981, p. 14) says "Competency-based education is a good idea, and vocational education is an especially fertile field for its application". In this study a comparison between traditional technical training and CBVE is made so that a reference for discussion can be established.

As opposed to traditional forms of trades training, Competency Based Vocational Education (CBVE) is based on the theory of mastery learning. Students proceed through the program by demonstrating mastery on a skill before being allowed to challenge a higher level skill. More importantly, students proceed through the program at their own pace. In competency-based learning, each student progresses at their own rate. In traditional classes, time is the constant, when the classes are over final exams

are held and some students may not pass. Because some students learn more slowly than others they may not master the material in the time allotted. If this is the case, students could fail the Apprenticeship exam. Although some students can achieve a passing grade on the final exit exams, others cannot. Because of these differences in achievement we can say that student achievement is varied. However, when individuals learn at their own rate time required for mastery varies but achievement is held constant. Students can take as much time as they require to accomplish the learning tasks (within reasonable limits) and become successful on the final exam because they challenge it when they are ready. At the time of this study the CBAT program at NAIT was capped at twelve weeks and students can take no more time than this. However, each student must master all skills to an acceptable level and therefore we can say that achievement is kept constant and time varies. Some students learn faster than others and those who do can actually complete the course requirements sooner. Blank (1980) summarizes the benefits of CBVE as follows. Each student has time to master each competency before moving on to the next. This type of education shortens training time for students. It meets the needs of special learners more effectively, by allowing them the flexibility to pursue the curriculum at their own rate and in the order they choose. It can reduce the failure rate because CBAT allows students to be examined when they feel ready for testing. This type of self-paced training program which

allows proficiency to be held constant does so by allowing training time to vary.

Unlike traditional instruction, CBVE students who do not meet the established criteria level must return to their studies and practise the content of the prior unit of instruction until they can pass at the prestated criteria level. At this point, intervention by the instructional staff suggesting alternative methods of studying the curriculum becomes critical to the success of the student with less aptitude for learning a particular unit.

In summary Spady (1977) summarizes Competency Based Vocational Education as follows:

1. Competence is indicated by successful performance on actual occupational tasks.

2. The development of vocational curricula requires, first, the identification and selection of discrete, observable occupational tasks which comprise the "essence" of the occupation.

3. The desired outcomes of instruction must be stated (and shared with the students) in terms of required criterion-referenced performance on the selected occupational tasks.

4. Instruction and evaluation must embody the criterion-referenced outcome statements.

5. The student is permitted to repeat both instruction and evaluation until the required performance is attained.

The exclusive criterion for student success (certification, graduation, etc.) is the verified demonstration of competence in the selected occupational tasks (p. 10).

Comparison of Traditional and CBVE Approaches

According to Knaak (1977), the major factors differentiating CBVE and traditional education are time required for instruction and method of testing. Traditional education uses norm-referenced testing while CBE uses criterion referenced testing. In norm-referenced testing each individual student's mark is compared to the rest of the class scores. An individual student's grade is usually based on comparison of his or her score to the scores of the other students. On the other hand, Popham (1978) says "A criterion-referenced test is used to ascertain an individual's status with respect to a well-defined behavioural domain" (p. 93). In criterion referenced testing, the student's score is a rating of how well he measures up against an external, pre-set standard. In this way, one student is not graded according to how all the other students have done, only by how they themselves have done.

In traditional education, the level of achievement required for an A or B grade is often not known to the student before the test results are available. About 25% of students, those achieving A or B grades, can ordinarily be regarded as having achieved 'mastery' of the content under this system. The remaining 75% are considered to have achieved less than mastery and they may not have learned essential knowledge or skills necessary for success in the next unit of learning (Knaak, 1977). In contrast, competency based education has been found in experiments by Block (1971) and Bloom (1976) to allow 75-95% of the students to achieve mastery. This high percentage of success compares favourably with the 25% achieving the criteria level in traditional instruction (Knaak, 1977).

However, in CBAT, a slightly different approach is used. At the outset, the students know in which direction the curriculum is heading because the performance objectives are stated up front. The students know in advance what is expected of them on each module and on the final exams. The standards or criteria of achievement are in the form of stated behaviors through which a student can demonstrate that he or she has learned the content of the instruction. These criteria are provided before instruction begins. Often traditional education does not make use of stated objectives, so the student is left on their own to try to determine the most important points in a lesson. By having the advantage of knowing the performance objectives in advance, students can

anticipate the content of exams. They know what the most important points are going to be in a lesson and they can pay close attention to them. Once the students write an exam they know that their mark is being compared not to the other students, but to a prestated and well defined performance standard. In this way students studying under CBAT do not compete with their fellow students, but rather they compete against an external standard.

Another difference between traditional and competency based education is the way in which instruction is delivered to the students. In CBVE instruction usually is not group centered, as previously described, but rather it is a series of individualized learning activities. CBAT allows students to progress at their own rate, working through a modularized curriculum. Student progress is monitored by a computer and the tests are received on a computer printout, as it is in computer managed learning. The modules are stand alone units containing all the information that the student needs to learn. CBAT makes use of print modules and student progress is monitored by computer. In a survey of the literature it was found that in many instances computer managed instruction (CMI) was used to accomplish mastery learning in technical vocations, such as basic electricity and electronics (Baker, 1978; Kearsley, 1983; Kearsley, Hunter, & Seidel, 1983; Kulik, Kulik, & Cohen, 1980).

When a student feels ready to be tested on the content of a specific module, he or she may take the test. In CBAT all tests are

computer generated. In CBVE it is not necessary for all students to take the same test at the same time. Also, the grading of these tests is criterion-referenced, and in this way they are seen as a student's mastery of specific behaviours (Glaser, 1963). This means that the mastery or passing level is prespecified, so that one student's grade is not compared to any others in determining standings. If the student passes the test(s) at the prespecified mastery level or above, he or she goes on to the next unit of instruction. Competency is considered as the a full completion of a whole unit of instruction and a typical pass mark in an Electrical CBAT module is set at 90%.

Given the above, and the fact that CBAT is a version of CBVE with the focus being on the Electrician trade, it would be useful now to examine cognitive style.

Field Dependence-Independence as a Cognitive Style

The major emphasis of this section of the literature review is on the historical development and present implications for students exhibiting the cognitive style FD-I. Cross (1976) said "usually, the term cognitive style is reserved for those dimensions that have their roots in the study of cognitive functioning in experimental research" (p. 113) in psychological laboratories and which are

subsequently applied to educational settings. Coop and Sigel (1971) said that "the term 'cognitive style' has been introduced and reintroduced into the psychological literature over a period of time that possibly extends back to the German psychologists at the turn of the century" (p. 152). This is corroborated by Kogan (1971) who said "a thorough account of the origins of the construct of cognitive styles would require a complete history of cognitive psychology" (p. 244). A review of this magnitude would be much greater than the scope of the present study.

The literature on Field Dependence-Independence is extensive, however, only those works which are most directly related to the present study are reviewed. Those references considered directly related to the history of the evolution and measurement of the construct of FD-I, the characteristics of FD-I learners, and the implications of FD-I for learning are included for review.

It was during the Second World War that differences in how people perceived their environment led to work which explored the concept to become known as FD-I cognitive style. It was noted that some pilots were able to fly long distances through thick clouds and not lose their orientation in relation to the horizon. Other pilots became disoriented after losing sight of the horizon (Wallace & Gregory, 1992). This observation led H.A. Witkin to use a darkened room in which he conducted experiments requiring subjects to determine the true vertical or upright, without help from any

visual reference to the horizontal plane. Witkin confirmed the characteristics observed in the pilots, and labeled those subjects capable of maintaining their orientation as 'field independent'. Those who needed an external reference to determine the horizontal or upright position he labeled 'field dependent' (Witkin et al., 1977b).

The growth of the concept of FD-I was tracked through the writings of Witkin and his colleagues. In the 1950s, Witkin began studying the perception of the true upright or vertical position in space (Witkin, 1950, 1952). This groundwork would become the basis for the present day construct of FD-I. Witkin's original studies used the Rod and Frame test (RFT), the Body-Adjustment Test (BAT), and the Rotating-Room Test (RRT). In these three tests, subjects were required to determine which direction was upright. Witkin (1978) noticed "in all three orientation tasks people differed markedly in the extent to which they used the body or visual field as referents for judging the upright" (p. 8). These studies led to the initial conceptualization of FD-I as the extent to which people "used the external visual field or the body itself as the main referent for locating the upright" (Witkin, Goodenough, Oltman, 1979, p. 128). In a further study, undertaken in an attempt to discover the basis of observed differences in perception among individuals, Witkin first used the embedded figures test (EFT) (Witkin, Lewis, Hertzman, Machover, Meissner and Wapner, 1954). This test required subjects to locate a simple geometric figure hidden within

a larger complex figure. When it was found that a person's manner of locating the upright was related to ease in locating the simple figure, FD-I was redefined "as the ability to overcome an embedding context in perception" (Witkin and Goodenough, 1977, p. 29).

In 1971, Witkin and his associates developed the Group Embedded Figures Test (GEFT). This was a pencil and paper test which consisted of 25 figures (7 of which are for practise and are not scored), in which the subject recognizes and traces a simple figure within a complex design. The GEFT is a timed test (12 minutes), which can be administered to a group of subjects. The subjects' score is the number of simple figures correctly located during the allotted time. The GEFT has a test-retest reliability index of .82 (Witkin, Oltman, Raskin, Karp, 1971). Much applied research especially in the field of education has utilized the GEFT.

With respect to age, there seems to be general agreement found on its relationship to FD-I. Witkin, Goodenough and Karp (1967) found an increase of FI until the ages of 15-17, at which time there was a leveling off. They also found that FD-I was relatively stable over time. Individuals for the most part maintained their position on the FD-I continuum relative to their peers. In their test manual for the GEFT, Witkin, Oltman, Raskin and Karp (1971) state that "at some point between 24 years and old age the process of increasing field dependence begins, the limited

evidence now available from cross-sectional studies suggest that this point may be somewhere in the late 30s" (p. 5).

Witkin also found a difference between FD-I persons with respect to their social orientation. FD people may make use of other people for their own acquisition of information by "spending their time with others, and even near others, in contrast to field independent persons who favour solitary, impersonal situations and who prefer to maintain their distance from others" (Witkin, 1978, p. 53). Rosenberg, Mintz, & Clark (1977), Wehmeyer (1984), Wittrock (1978), and Dixon (1977) all reported some differences between FD-I learners and these are summarized in Appendix B.

The literature on choice of career or vocation was reviewed by Witkin, Moore, Goodenough, and Cox (1977) and has shown that while relatively FD and FI students do not differ on overall college achievement measures such as grade point average, they do differ in course selection and in vocational choice. Witkin et al. (1977) concluded that "relatively field-independent persons favour impersonal domains...and field dependent persons favour interpersonal domains" (p. 43). In addition, a longitudinal study by Witkin, Moore, Oltman, Goodenough, Friedman, Owen and Raskin (1977) which followed 1548 students from college entrance until entry into graduate or professional school has presented strong evidence of a relationship between FD-I and academic choices. FI students were more likely to choose the natural sciences such as

mathematics or engineering, while FD students were more likely to choose the social sciences such as sociology or languages.

Witkin et al. (1977a) have determined that Field Dependence-Independence cognitive styles are bi-polar such that "each pole has adaptive value in special circumstances" (p. 16). In addition, researchers generally agree that these two categories have no particular stigma attached to them. The two extremes of FD and FI are neutral in value and neither indicates a preferred place on the continuum of cognitive style. These two polarities are not to be construed as preferred abilities (Messick, 1984; Witkin, Moore, Goodenough, & Cox, 1977). Witkin (1977) also goes on to say that these cognitive styles do not differ appreciably in learning ability or memory, but they are "more related to the 'how' than to the 'how much' of cognitive functioning" (p. 24).

In conclusion, the cognitive style of Field Dependence-Independence is well suited to this study involving Electrician apprentices studying under CBAT. The GEFT is quickly and easily administered and the results distribute the respondents along a continuum. These resulting scores range from 0 or 1 indicating Field Dependence, all the way up to a maximum value of 18, indicating Field Independence. The GEFT is quick and easy to administer and it gives results which are both reliable and valid (Witkin, 1977). It is often used in educational studies and has a good test-retest reliability.

The search of the literature provided many examples of the Group Embedded Figures Test being used as a determinant of FD-I as a cognitive style. Many of these studies have been in the field of education. The sample populations range from grade school children through secondary school and college to university and graduate school. While many studies have been undertaken with technical students such as military radio technicians (Federico, 1982) and university students (Chinien, 1990), only one study has been found which deals with apprentices themselves (Moran, 1986). Therefore, the present study is somewhat unique because it deals with apprentices in general and Electrician apprentices in particular. The following studies illustrate some of the work done with a variety of groups.

Witkin et al. (1977a) tried to determine if there was a relationship between academic achievement and cognitive style of FD-I. They found at the pre-school and elementary school level that there was a definite relationship between field dependence and achievement. However, they found only weak or no significant relationship between cognitive style and achievement at the high school and college levels. They conducted longitudinal research and found correlations of .05 for women and .08 for men. In another study dealing with high school drafting students, Guster (1986)

attempted to see if there was a relationship between achievement in technology courses and FD-I. He found that FI students did better academically than FD students. However, none of these studies involved apprenticeship students.

In 1987 Davis undertook a study with elementary students and tried to find a relationship between reading performance and FD-I. Caliste (1985) worked with junior high students looking for a relationship between FD-I and selected performance variables. Lotwick, Simon, and Ward (1980) found that science and engineering faculty tended to be more field independent than non-science and education faculty.

The search of the literature did uncover two studies directly relevant to the current study. Moran (1986) conducted research into the FD-I cognitive style of Electrician apprentices. He found that in selected aspects of electrical fault diagnosis, field independent Electrician apprentices performed significantly better than their field dependent coursemates. This finding substantiates that of Rouse and Rouse (1982), who also studied problem solving in electrical fault diagnoses. These two studies are the only ones found to be directly concerned with cognitive style and FD-I of Electrical workers.

The lack of research on apprenticeship is comparable to the lack of research on competency based education in general. Miller's (1982) survey of board members of the Journal of Industrial

Teacher Education illustrates this point well. He found that of the fifty topics these board members said needed to be researched, the evaluation of CBVE ranked sixth. This lack of research and the fact that CBVE is gaining in popularity, points to the need for more work in this area. The TAFE Report (1985) notes this need precisely when it says "It would be informative, too, if we had data on what student types- for example, nature and length of work experience, learning preferences, cognitive styles, and intelligence-learn the most effectively within CBVE programs" (p. 16).

The literature review highlighted several aspects which are considered important to this research. An ex post facto study was conducted using the GEFT as the instrument to determine Field Dependence-Independence. This test is quick and easy to administer to large groups and produces valid and reliable results. The traditional form of apprenticeship technical training was discussed with a focus on the issue of a fixed amount of time for instruction. Time is of secondary importance in Competency Based Vocational Education because mastery of performance objectives is most critical and time is allowed to vary. Another major difference between traditional and competency based education is the way in which students are graded; CBVE uses criterion-referenced grading while traditional education uses norm-referenced grading. A pencil and paper test to determine FD-I evolved from Witkin's original works studying bodily orientation in space to determine the true upright. The GEFT is used to determine whether a subject is Field

Independent or Field Dependent; these two attributes are on opposite ends of a continuum, each one having strengths in different circumstances. There is no stigma attached to these different poles nor are they to be related to intelligence. Finally, this chapter identifies the lack of research done with apprentices especially with respect to cognitive style. It is well to note that very little research has been done with apprenticeship students and this area is awaiting further investigation. It is hoped that the present study will stimulate interest in the area of cognitive styles, especially with apprenticeship students.

Chapter Three

Methodology and Data Collection

The purpose of the present study is to determine if a relationship exists between cognitive style, academic success, age, and time on task for Second Period Electrician apprentices enrolled in Competency Based Apprenticeship Training at the Northern Alberta Institute of Technology. This study attempts to ascertain if Field Dependence-Independence as a measure of cognitive style varies with academic success, age, or time on task. This study is ex post facto research which Kerlinger (1979) defines as,

> Ex post facto research is systematic empirical inquiry in which the scientist does not have direct control of independent variables because their manifestations have already occurred or because they are inherently not manipulable. Inferences about relations among variables are made, without direct intervention, from concomitant variation of independent and dependent variables (p. 379).

The independent variable is Field Dependence-Independence as a cognitive style. The dependent variables are academic success, or grades achieved (as expressed in percentages) on both the NAIT final exams and the Apprenticeship Board exam and the ages of the apprentices, as measured in years. These ages are taken from the month they completed the GEFT, i.e. August, 1991. The last dependent variable is time on task, as determined by the length of time it takes an apprentice to complete the period of study. This variable is measured in hours and could easily be converted to days, as there are 6 hours in one school day.

Sample

The subjects participating in this study were the August 27, 1991 intake of Second Period Electrician apprentices enrolled in CBAT at NAIT. This registration was projected to enroll sixty students of whom 58 were actually present at the time of the study. All these male students volunteered to participate in this research; they all signed the Letter of Permission (Appendix A).

Validation

The GEFT, although first developed in 1971, has continued to prove to be valid and reliable, according to Witkin (1977). Witkin et al. (1971) determined the construct validity of the GEFT by comparing subjects' scores on the Rod and Frame Test to the GEFT (average correlation of .375 for male and female subjects). "The test-retest reliability index of the GEFT is .82" (Heitmeyer and Thomas, 1990, p. 145).

Scoring of Data

The GEFT was scored by the researcher during the period of time immediately following the administration of the test. The GEFT was again marked several weeks later to confirm that the original scoring was correct. Both the time on task data and the final exam results were collected after all the students had exited the program. See Appendix C for all these test results.

Instrumentation

The GEFT as developed by Witkin et al. (1971) differentiates among respondents on the basis of their ability to detect a simple form in a background of a more complex figure. This pencil and paper test was used to determine the respondents' cognitive style. The results of the GEFT appeared as a distribution along a continuum. The continuum ranged from Field Independence, with a maximum possible score of 18, wherein the subject had no difficulty in detecting the figure, to Field Dependence, with a score at or approaching 0, wherein the respondents had greater difficulty in disembedding or detecting the simple form. The actual scores for this sample ranged from a maximum of 18 to a minimum of 1. The median score was 13, with five participants achieving this score. The mean was 12.4. This data is presented in Table 1 on page 39.

Table 1

Summary of Raw Data

Variable	Mean	SD	Minimum	Maximum
GEFT	12.38	4.54	1	18
Age	26.28	6.31	20	57
Apprenticeship Exam	73.55	7.47	59	97
NAIT Exam	80.88	6.02	67	94
Hours	232.78	47.15	118	352

(n=58)

Because of the provisional nature of the GEFT, the Test Manual for the GEFT (Witkin et al., 1977) does not specify a cut off point for Field Dependence-Independence. This researcher choose to analyze the data two ways, once using a mean split and once using a median split. Since the actual median score was located second in the series of the five scores of 13, all those respondents achieving 13 were included in the Field Dependent category. This division was done on the recommendation of the research statistician Roy Jaffray (personal communication, March 31, 1994). This median split resulted in a Field Independent group (n=27) and a Field Dependent group (n=31) which were comparable in size.

On the other hand, the procedure for performing the mean split resulted in two groups, one of which was nearly twice the size of the other. Based on normative data provided by Renna and Zenhausern (1976) and Dumsha et al. (1973) the cut-off score between FD and FI is presumed to lie between twelve and thirteen. The actual calculated mean was 12.4, therefore scores of 12 were removed from the sample resulting in a FI group (n=32) and a FD group (n=18). This split provided two groups which tended to show the cognitive style FD-I to the greatest extent because the central scores were eliminated. The mean was taken as the point which divided the groups into Field Dependent and Field Independent.

Collection of Data

Data collection took place during the NAIT orientation for the Second Period Electrician class on August 27, 1991. NAIT staff who helped invigilate the Group Embedded Figures Test were first given a familiarization to the GEFT by the researcher. This orientation consisted of a brief overview of FD-I as a cognitive style and the actual rules for the administration of the test. The NAIT Electrician Program staff were very helpful in facilitating the delivery of the test.

A brief explanation of the purpose of the study was given to the 58 Electrical students. They were assured by this researcher that their anonymity would be protected and that their responses to test items would not affect their grades in any way. After reading and signing the Letter of Permission, participants completed the GEFT. All 58 students present consented to partake in the research.

Participants were asked to read the instructions and complete the practice items in the GEFT test booklet. When this was done, the directions were reviewed and questions relating to the directions answered. This was followed by three consecutively timed test sessions during which the subjects attempted to locate and outline simple geometric figures embedded within complex

figures. The first timed session of two minutes was primarily for practise. The two remaining five minute sessions constituted the test portion from which the final score was derived.

Directions for test administration provided by Consulting Psychologists Press, Inc. were carefully followed. This researcher was careful not to give the students any hints or otherwise influence their choice of answers. Total intervention time of the NAIT orientation was approximately 40 minutes. For verification of scoring accuracy, tests were scored twice by this researcher, once on the actual day of completion and again several weeks later.

Achievement data (grades in percentages) and time on task data were collected by this researcher from NAIT files and from the files of Apprenticeship and Trades Certification Division of Alberta Career Development and Employment after all students had completed and exited the program.

Analysis of the Data

The SPSS-x statistical program was used to analyze the data. T-tests were utilized in the analysis of the data along with Levine's test for equality of variance.

Summary

The Electrician apprentice students were addressed by the researcher during the NAIT student orientation at which time they were offered the opportunity to participate in the study. The GEFT was administered to the students at this time also. The records of academic success were retrieved from the NAIT files at the end of the course. The results of the Alberta Apprenticeship exams were accessed with the written permission of the participants and the cooperation of the Alberta Apprenticeship Board.

This was an ex post facto study. The 58 Electrician apprentices were enrolled in the second period of their four periods of technical training. Data collection was done during the NAIT orientation to second period technical training. Students completed both a letter of permission and the Group Embedded Figures Test. Achievement scores and times on task were obtained from NAIT files. Results of the Apprenticeship Board exam were obtained from the Alberta Apprenticeship Board files. The SPSS-x statistical package was used to perform t-tests on the data.

Chapter Four

Findings of the Research

This chapter presents the results of the study. The two methods of discussing the interpretation of the data are given consecutively. The researcher first discusses analysis of the data using a 'mean split'; then follows this with an analysis of the data using a 'median split'. A summary of the findings and a discussion of their interpretation concludes the chapter.

The complete second period class of male Electrician apprentices in the August 27, 1991 intake at NAIT made up the sample. All students agreed to partake in the study and completed a Letter of Permission granting their consent to be included in the study. During the NAIT orientation the researcher administered the GEFT with help from NAIT Electrician program staff.

Mean Split

The GEFT manual does not specify how the two groups (FD-I) are to be divided and this was confirmed by Donna B. Gates of Consulting Psychologists Press (personal communication, April 5,

1994). Given this, the researcher chose to divide and interpret the GEFT results two ways. First of all a 'mean split' was used wherein the mean score of 12 was used as the separation point between the two groups. The Manual for the GEFT (1971) states that normative mean values for male respondents is 12. Using this calculation all eight scores of 12 were dropped from the study. This resulted in a FI group (n=32) almost twice the size of the FD group (n=18).

A test of variance was run on both FD-I groups with respect to all four of the dependent variables-Apprenticeship exam (p=.463), NAIT exam (p=.963), age (p=.198), and time on task (p=.976). In all four cases there was no significant difference in the variance of the two groups, thus allowing t-tests to be run. Refer to Table 2 below.

Table 2

Results of Test for Equality of Variance for FD-I Groups-Mean Split

Variable	Probability
Apprenticeship Exam	.463
Age	.198
NAIT Exam	.963
Time to Completion	.976

When t-tests were conducted using two-tail significance for each of the four variables none produced significant results. Apprenticeship exam (t=1.77, df=48, p=.083), NAIT exam (t=1.59, df=48, p=.119), Age (t=.02, df=48, p=.986), and Time on task (t=1.25, df=48, p=.216). This information is presented in Table 3 on page 47.

It is interesting to note that this 'mean split' resulted in two groups with one group (FI) nearly twice as large as the other (FD). However, in this analysis, not one of the four dependent variables was significant (p>.05). Therefore, the remainder of this report will focus on the median split analysis.

Table 3

Results of t-tests on FD-I Groups using Mean Split

	Cognitive Style	N	Mean	SD	SE	t	df	p 2-tail
Hours	FI	32	228.97	42.65	7.54	1.25	48	.216
	FD	18	245.11	45.46	10.71			
Apprentice-ship Exam	FI	32	75	7.582	1.340	1.77	48	.083
	FD	18	71.33	5.89	1.39			
NAIT exam	FI	32	82.09	5.85	1.03	1.59	48	.119
	FD	18	79.39	5.66	1.33			
Age	FD	32	26.31	4.99	.882	0.02	48	.986
	FI	18	26.28	8.93	2.11			

Median Split

The second method used to analyze the data was one using a median split. There is evidence in the literature for the use of this method (MacNeil, 1980; Rouse & Rouse, 1982). The median score on the GEFT was 13, with five respondents having this score. The actual median was the second of the five, measuring down from the maximum score of 18. This researcher included all five median scores of 13 in the FD group because they tended to lie in that direction (R. Jaffray, personal communication, March 31, 1994). This median split divided the sample into two groups of nearly equal size (FI n=27 and FD n=31). A test of variance was run on both FD-I groups with respect to all four of the dependent variables-Apprenticeship exam (p=.916), NAIT exam (p=.997), age (p=.699) and time on task (p=.142). In all four cases, no significant difference in the variance of the two groups was found, thus allowing t-tests to be run. This information is presented in Table 4 on page 49.

Table 4

Results of Test for Equality of Variance for FD-I Groups-Median Split

Variable	Probability
Apprenticeship exam	p=.916
Age	p=.699
NAIT exam	p=.997
Time to Completion	p=.142

When t-tests were conducted using two-tail significance for each of the four variables, three produced significant results- Apprenticeship exam (t=2.15, df=56, p=.036), NAIT exam (t=2.33, df=56, p=.024), and Time on task (t=2.22, df=56, p=.030). The t-test performed on the dependent variable age did not produce a significant result (t=.27, df=56, p=.791). See Table 5 on page 50 for this information.

Table 5

Results of t-tests on FD-I Groups- Median Split

	Cognitive Style	N	Mean	SD	SE	t	df	p 2-tail
Hours	FI	27	218.52	37.46	7.21	2.22	56	.030
	FD	31	245.19	51.62	9.27			
Apprentice-ship Exam	FI	27	75.74	7.52	1.45	2.15	56	.036
	FD	31	71.64	6.99	1.256			
NAIT exam	FI	27	82.78	6.01	1.16	2.33	56	.024
	FD	31	79.23	5.60	1.01			
Age	FI	27	26.04	5.24	1.01	0.27	56	.791
	FD	31	26.48	7.19	1.29			

The t-test on the dependent variable academic success on the Apprenticeship exam produced significant results. Based on this finding the null hypothesis can be rejected. It was found that there is a significant difference between FD-I students and academic success on the Apprenticeship board exam. The FI students tend to do better, achieving a higher grade than the FD students on this exam.

The t-test on the dependent variable academic success on the NAIT exam also produced significant results. Based on this finding the null hypothesis can be rejected. It was found that there is a significant difference between FD and FI students and academic success on the NAIT exam. The FI students tended to do better, achieving a higher grade than the FD students on this exam.

The t-test on the dependent variable time to completion also produced significant results. Based on this finding the null hypothesis can be rejected. It has been found that there is a significant difference in time to completion for FD and FI students. The FI students tended to complete their program of studies faster than the FD students.

Discussion of the Findings

FI Electrician apprentices enrolled in CBAT scored higher than FD students on both the NAIT final exams and the Apprenticeship Board exams. The FI students scored an average of 4.1 % higher than the FD students on the Apprenticeship exam and an average of 3.55 % higher on the NAIT exam. This finding would indicate that FD students are not as successful on these two exams. However, the question remains as to the actual degree of difference this represents. Further research is indicated to try to determine if these differences are indeed significant. The point however, can still be made that FD students are disadvantaged on these exams when compared to their FI coursemates. With respect to time to completion though these same FI students were able to complete their course of studies faster than the FD students. The difference noted here was 26.67 hours or just slightly over 4 days. This is about a 10% difference in total time and appears to be a substantial amount. However, the use of home computers or prior experience working with computers was not studied, and this could have been a contributing factor to time. Finally, there was no significant difference found in age between these two groups.

Chapter Five

Summary

This was an ex post facto study undertaken to determine if a relationship existed between the cognitive style of Field Dependence-Independence and selected variables in the CBAT instructional approach. The variables were academic success, student age, and time on task. The August 27, 1991 NAIT intake of second period Electrician apprentices enrolled in CBAT formed the sample. This resulted in a sample size of 58 having a mean age of 26 years. The GEFT was administered at the NAIT orientation resulting in a range of scores from 1 to 18, with a mean score of 12. School files (NAIT) and Apprenticeship Branch files were the source for exam results. These exam results were analyzed using the SPSS-x statistical package at CRAME in the University of Alberta. Four null hypotheses were tested at the .o5 level of confidence. The following conclusions were reached based on the outcome of these computerized analyses. The 'median split' method of determining the two groups FI and FD produced significant findings and is therefore discussed. The 'mean split' method of determining the two groups (FD-I) did not produce statistical significance and is not discussed here.

Conclusions

Field Independent students tended to score higher on both the NAIT exam (82.78% vs. 79.23%) and the Apprenticeship exam (75.74% vs. 71.64%) than Field Dependent students. Therefore, it can be said that they were more successful than their FD counterparts. This finding tends to suggest that FI students had less trouble learning the curriculum in CBAT than FD students. CBAT as an approach to learning in the Electrician trade might favour those students who are Field Independent. Indeed, the literature corroborates this finding. When students are able to study at their own pace, research confirms the proposition that field-independent learners perform better than field dependent learners (Brooks, 1976; Wallace, 1980). The fact that Field Independent students tended to do better than FD students suggests FI students are able to cope with the curriculum and the way in which it was presented better than FD students. According to Witkin, FI students do generally exhibit traits which would substantiate this finding. It appeared that the FI students in this sample tended to be more successful at isolating the elements from the surrounding background. Since they were more successful one might assume that they had fewer problems coping with the curriculum and they were thus more able to successfully complete their school work. These FI students were able to work through the

curriculum faster and more successfully than FD students and this is also what Witkin (1977) would have predicted. He says FI students do well when they work alone. This finding is supported by what Wittrock (1978) found in his study. He said that FI students have the ability to see separate parts as a total pattern. These students would be able to take the individual modules which make up the CBAT curriculum and put them all together and see how they are interrelated. FI students do not seem to have difficulty with the curriculum in that they are able to piece it all together to form a whole. They were able to deal with the curriculum in a positive manner such that they were able to exhibit academic success.

Dixon (1977) said that FI people tend to be competitive and this may be illustrated by the fact that they spent less time on the course than FD students. If students are competitive they may want to accomplish the task faster than their fellow student. The fact that FI students also tended to complete their studies under CBAT faster than their FD counterparts could be construed as a measure of success. They not only scored higher on their exams as a group, but they also achieved this in a shorter period of time. Indirectly, this can be viewed as being more able to deal with the curriculum in a successful manner.

Factors not Studied

The three factors of feedback, the size of the modules and independent work were not studied in this research. However, the literature had some significant things to say about these three areas. First of all Dixon (1977) found that FI students did not require as much feedback as FD students. This could be an issue in Computer Managed Learning wherein the students spend a significant amount of time working alone or at computer terminals. McLeod, Carpenter, Thomas, McCornack, and Skvarcius (1978) investigated the interaction between Field Dependence-Independence and selected instructional methods. They reported that FI students perform better when allowed to work independently, and that FD students learn more when they have extra guidance from the teacher.

Cross (1976) discussed the implications of the cognitive style of FD-I for educational practice. She cited research which indicated that FI students were able to deal with larger instructional modules and require less frequent feedback than FD students. These findings were corroborated by the work of Renzi (1974) and Schwen (1970).

Jacobs and Gedeon (1982) studied the relationship between Field Dependence-Independence and the frequency of

student/proctor interactions and achievement in a Personalized System of Instruction (PSI) course. They reported that FI persons are significantly more likely to show greater autonomy of others in social situations. FD persons on the other hand are more likely to be oriented toward other persons. They suggested that FI students had learned to rely on internal referents and were less dependent upon the proctors to provide information and structure.

Recommendations

This research indicates that to a degree FI students are more successful than FD students while studying under CBAT. Because this study looked at Second Period Electrician apprentices, some assumptions can be made about the sample. They must all have some basic academic abilities to have made it through the First Period of technical training. Although the FD students did more poorly than the FI students it is probably safe to say that this difference was not due to intellectual ability. This study shows that FD students are somehow disadvantaged when studying under CBAT and this may have to do with their inability to 'disembed' the important information from the curriculum. In order to address this disadvantage, one suggestion would be to have the modules summarized at the outset and to have the important aspects of a module highlighted. Secondly, a conceptual map could be provided

in each subject area to allow FD students to see the program overview in advance of instruction. In this way, FD students could formulate an idea of the depth and breadth of the course material at the outset. This could be achieved by providing both outlines and objectives in advance of any student commencing a module. "Providing FD students with structural support such as an outline...would aid their comprehension and recall because such an organizational aid should complement their passive approach to learning" (Frank, 1984, p. 671). Modules should also tend to be smaller rather than larger in size. If FD students appear to become overwhelmed by the size of the modules, decreasing their size may be a solution.

Finally, it might be feasible to provide the FD learners with actual instruction on how best to deal with the curriculum. Students could all be assessed as to their learning style in advance of the course and the implications of their particular learning style be made known to them. They could be advised of the limitations one style might have over another and of strategies that could be used for overcoming these limitations.

This study indicates that CBAT as an instructional strategy is appropriate for FI learners and puts FD learners at a disadvantage. The literature supports this finding for vocational areas of study. If CBAT as an instructional methodology were to be used in non-vocational areas of study such as the humanities, it might be advisable to investigate this in advance. It appears that vocational

and trades areas are suited to CBAT because the students who chose these vocational areas tend to be FI. However, because FD students tend to chose the humanities as an area of study CBAT may be a poor choice of instructional strategy for these disciplines.

Areas for Further Study

This ex post facto study was of the cross-sectional type. The researcher intervened at a specific time and administered the GEFT. The results of this study might suggest that a longitudinal study as postulated by Block (1971) be undertaken. It would be interesting to track a class of Electrician apprentices through their four periods of study in CBAT. A longitudinal study as suggested here could show if one period of study gave a particular group more difficulty than another. It would also be interesting to find out if an investigation into all four periods of technical training resulted in consistent results with respect to the favouring of one cognitive style over another.

Another type of study which could be undertaken is the aptitude-treatment interaction (ATI) as suggested by Cronbach and Snow (1977). Here a true experimental type of study is suggested, with one group studying under CBAT and a control group studying under traditional classes. This research could point to differences

in student performance in both instructional methods. This researcher also sees benefit to tracking student time on task for each CBAT module, in an attempt to identify any problematic modules. Finally, Post (1987) suggests that both a FD and FI person be consulted when modules are being created. Having the two types of persons review the curriculum in advance might help to remove any bias which could become embedded in the modules themselves.

Various types of studies are indicated here but it should be emphasized that more research is needed in this area. The present study seems to indicate that FD apprentices are disadvantaged when studying under CBAT but even this finding requires further scrutiny. Research into modifications or adaptations to the CBAT methodology to address the needs of FD learners is a possibility. The embellishment of the small group format currently used with CBAT students at NAIT would be another area which might offer some advantage for FD students. This is open to further research.

It is hoped that this study ignites a spark of interest in the area of research into cognitive style and apprenticeship. It is wished that in some small way, this study provides some answers to questions which ought to be asked. In any event, the field of research into apprenticeship and cognitive style remains ready for more research.

References

Apprenticeship and Trade Certification (1993). Competency based apprenticeship training: a new approach. Alberta Career Development and Employment. (pamphlet)

Ary, D., Jacobs, L.C., & Razavieh, A. (1990). Introduction to Research in Education, (4th ed.) Toronto: Holt, Rinehart, & Winston.

Baker, F. (1978). Computer-managed instruction:Theory and practice. Englewood Cliffs, NJ: Educational Technology Publications.

Blank, W.E. (1980). Competency-based education: is it really better? School Shop, 39(8), 31-34.

Block, J.H. (1971). Mastery Learning Theory and Practice. New York: Holt, Rinehart, & Winston.

Bloom, B.S. (1976). Human characteristics and school learning. New York: McGraw-Hill.

Brooks, M.L. (1976). Field-dependent and field independent cognitive styles and their relationship to health science students performance on mediated self-instruction. Unpublished doctoral dissertation, Georgia State University.

Burleigh, A. (1988). New Zealand updates apprenticeship. Vocational Education Journal, 63(3), 36-38.

Caliste, E.R. (1985). The relationship between the Group Embedded Figures Test and selected performance variables, Performance and Instruction Journal, 24, 26-28.

Candy, p. and Harris, R. (1990). Implementing competency-based vocational education. Journal of Further & Higher Education, 14, 38-57.

Chinien, C.A. (1990). Examination of cognitive style FD/FI as a learner selection criterion in formative evaluation. Canadian Journal of Educational Communication, 19(1), 19-39.

Coop, R.H. & Sigel, I.E. (1971). Cognitive style:Implications for learning and instruction. Psychology in the schools, 8, 152-161.

Cronbach, L.J. & Snow, R.E. (1977). Aptitudes and Instructional Methods. New York: Irvington.

Cross, p. K. (1976). Accent on learning, San Francisco, CA: Jossey-Bass Publishers.

Davis, J.K. (1987). The field independent-dependent cognitive style and beginning reading. Early Child Development and Care, 29, 119-132.

Dixon, C. (1977). Matching reading instruction to cognitive style for Mexican-American children. paper presented at the California Reading Association, Anaheim,CA (in Educational Psychology, Winzer & Grigg (Eds.)).

Dumsha, T.C., Minard, J., and McWilliams, J. (1973). Comparison of two self-administered field dependency measures. Perceptual and Motor Skills, 36, 252-254.

Federico, p. A. (1982). Individual differences in cognitive characteristics and computer-managed mastery learning. Journal of Computer-Based Instruction, 9(1), 10-18.

Federico, p. A. (1986). Crystallized and fluid intelligence in a "new" instructional situation. Contemporary Educational Psychology, 11, 33-53.

Florida Department of Education (1976). Delivering Competency-based vocational education. Tallahassee: Florida Department of Education.

Frank, B.M. (1984). Effect of field independence-dependence and study technique on learning from a lecture. American Educational Research Journal, Fall, 21(3), 669-678.

Glaser, R. (1963). Instructional technology and the measurement of learning outcomes-some questions. American Psychologist, 18, 519-521.

Green, D. and Parker, R.M. (1989). Vocational and academic attributes of students with different learning styles. Journal of College Student Development, 30, 395-400.

Guskey, T.R. (1985). Implementing Mastery Learning, Belmont, CA.: Wadsworth.

Guster, D. (1986). Cognitive style and drafting performance. Journal of Vocational Education Research, 11(1), 25-40.

Heitmeyer, J.R. and Thomas, H.B. (1990). Cognitive learning style dimensions in postsecondary home economics students. Journal of Studies in Technical Careers, 12(2), 139-152.

Hirst, B. (1977). The components of competency-based vocational education. American Vocational Journal, (November), 52-53.

Jacobs, R.L. & Gedeon, D.V. (1982). The social behaviours of field-dependent students in a personalized system of instruction course. International Journal of Instructional Media, 9(2), 145-157.

Kearsley, G. (1983). Computer-based training. Reading, MA: Addison-Wesley.

Kearsley, G., Hunter, B., & Seidel, R.J. (1983). Two decades of computer based instruction projects: What have we learned? T.H.E. Journal, 90-94.

Keefe, J.W. (1990). Learning styles:where are we going? Momentum. 30, 44-48.

Kerlinger, F.N. (1979). Foundations of behavioural research. (2nd ed.). New York: Holt, Rinehart, & Winston Inc.

Knaak, W.C. (1977). Competency-Based Vocational Education:A Review. ERIC Clearing House on Career Education, Columbus, Ohio.

Kogan, N. (1971). Educational implications of cognitive styles. In G.S. Lesser (Ed.), Psychology and educational practice. Glenview, IL: Scott, Foresman, & Company.

Kulik, J.A., Kulik, C.C., & Cohen, p. A. (1980). Effectiveness of computer-based college teaching:A meta analysis of findings. Review of educational research, 50, 525-544.

Leedy, p. D. (1989). Practical Research. (4th ed.) New York:Macmillan Publishing.

Lesser, G. (1971). Psychology and Educational Practice. Glenview, Il: Scott, Foresman, & Company.

Lotwick, G., Simon, A., & Ward, L.O. (1984). Field dependence-independence and its relationship to E and N in male and female polytechnic students. Personality and Individual Differences, 5(4), 475-476.

MacNeil, R.D. (1980). The relationship of cognitive style and instructional style to the learning performance of undergraduate students. Journal of Educational Research, 73, 354-359.

McLeod, D.B., Carpenter, T.P., McCornack, R.L., & Skvarcius, R. (1978). Cognitive style and mathematics learning: the interaction of field independence and instructional treatment in numeration systems. Journal for Research in Mathematics Education, 9(3), 163-174.

Merriam, S.B. & Simpson, E.L. (1984). A Guide to Research for Educators and Trainers of Adults. Malabar, FL: Robert E. Krieger Publishing.

Messick, S. and associates.(1976). Individuality in learning. San Francisco: Jossey-Bass Publications.

Messick, S. (1984). The nature of cognitive styles:Problems and promise in educational practice. Educational Psychologist, 19, 59-74.

Miller, p. W. (1982). Possible topics that should be investigated by prospective authors for the Journal of Industrial Teacher Education. Journal of Industrial Teacher Education, 19(3), 3-10.

Moran, A.P. (1986). Field independence and proficiency in electrical fault diagnosis. IEEE Transactions on Systems, Man, and Cybernetics, 16, 162-165.

Moss, J. Jr. (1981). LCBE:Limiting competency-based education (or) let's curb behavioral excesses. Journal of Industrial Teacher Education, 19(1), 14-18.

Mouly, G.J. (1970). The Science of Educational Research, 2nd ed. New York: Van Nostrand Reinhold.

NAIT Bulletin DB.1 (1988). Access to NAIT staff and students by external researchers. (bulletin)

Pintrich, p. R. and Johnson, G.R. (1990). Assessing and improving students' learning strategies. New Directions For Teaching and Learning, 42, 83-92.

Popham, W.J. (1978). Criterion-Referenced Measurement. Englewood Cliffs, NJ: Prentice-Hall, Inc.

Post, p. E. (1987). The effect of Field Independence/Field Dependence on Computer-Assisted Instruction Achievement. Journal of Industrial Teacher Education, 25(1), 60-67.

Price, G. (1983). Diagnosing learning styles. New Directions for Continuing Education, 19(9), 49-55.

Renna, M. and Zenhausern, R. (1976). The group embedded figures test:normative data. Perceptual and Motor Skills, 43, 1176-78.

Renzi, N.B. (1974). A study of some effects of field dependence-independence and feedback on performance achievement. Unpublished Ph.D. dissertation, Hofstra University.

Rosenberg, H.R., Mintz,S., & Clark, R.E. (1977). The educational significance of field dependence research. Educational Technology, 17, 43-44.

Rouse, S.H. and Rouse, W.B. (1982). Cognitive style as a correlate of human problem solving performance in fault diagnosis tasks. IEEE Transactions on Systems, Man, and Cybernetics, 12, 649-652.

Schwen, T.M. (1970). The effect of cognitive styles and instructional sequences on learning a hierarchical task. Unpublished Ed.D. dissertation, Indiana University.

Smith, R.M. (1982). Learning how to learn:Applied theory for adults. Chicago: Follett.

Spady, W.G. (1977). Competency based education:A bandwagon in search of a definition. Educational Researcher, January, 9-14.

TAFE National Centre for Research and Development Ltd. (1985). Competency based vocational education:An evaluation. Payneham, South Australia: D.J. Woolman Government Printer, South Australia.

Walker, T.J., Merryman, J.E., & Staszkiewicz (1984). Identifying learning styles to increase cognitive achievement in a vocational teacher education program. Journal of Industrial Teacher Education, 22(1), 27-40.

Wallace, S.G. (1980). The effects of cognitive style and modality of study on achievement in self-paced instruction. Unpublished doctoral dissertation, Texas A&M University.

Wallace, S.G. & Gregory, R.A. (1985). Cognitive Styles:the unaccommodated variable in training design decisions. Performance and Instruction Journal, (May), 22-23.

Wapner, S. (1954). Personality through perception. Westport, CT:Greenwood Press, 1972. (Originally published Harper).

Wehmeyer, L.B. (Ed.) (1984). School librarian as educator, Littleton,CO: Libraries Unlimited.

Winzer, M. & Grigg, N. (Eds.) (1992). Educational Psychology in the Canadian Classroom. Scarborough: Prentice-Hall.

Witkin, H.A. (1950). Perception of the upright when the direction of the force acting on the body is changed. Journal of Experimental Psychology, 40, 93-106.

Witkin, H.A. (1952). Further studies of perception of the upright when the direction of the force acting on the body is changed. Journal of Experimental Psychology, 43, 9-20.

Witkin, H.A. (1978). Cognitive styles in personal and cultural adaptation. Worcester, ME: Clark University Press.

Witkin, H.A. & Goodenough, D.R. (1977b). Field dependence revisited. Princeton, NJ: Educational Testing Service.

Witkin, H.A. & Goodenough, D.R. (1981). Cognitive styles: Essence and Origins. Field dependence and field independence. Psychological Issues, 14, (Whole No.51).

Witkin, H.A., Goodenough, D.R. & Karp, S.A. (1967). Stability of cognitive style from childhood to young adulthood. Journal of Personality and Social Psychology, 7, 291-300.

Witkin, H.A., Goodenough, D.R. & Oltman, p. K. (1979). Psychological differentiation: Current status. Journal of Personality and Social Psychology, 37, 1127-1145.

Witkin, H.A., Lewis, H.B., Hertzman, M., Machover, K., Meissner, p. B. & Wapner, S. (1954). Personality Through Perception. New York: Harper.

Witkin, H.A., Moore, C.A., Goodenough, D.R., & Cox, p. W. (1977a) . Educational implications of cognitive styles. Review of Educational Research, Winter, 47(1), 1-64.

Witkin, H.A., Moore, C.A., Oltman, p. K., Goodenough, D.R., Friedman, F., Owen, D.R., & Raskin, E. (1977). Role of field-dependent and field-independent cognitive styles in academic evolution:A longitudinal study. Journal of Educational Psychology, 69, 197-211.

Witkin, H.A., Oltman, p. K., Raskin, E., & Karp, S.A. (1971). A manual for the Embedded Figures Tests. Palo Alto, CA: Consulting Psychologists Press.

Wittrock, M.C. (1978). Education and the cognitive processes of the brain. In J. Chall & A. Mirsky (Eds.) Education and the brain:The Seventy Seventh yearbook of the Society for the Study of Education, Part 2. Chicago: University of Chicago Press.

APPENDIX A

Letter of Permission

LETTER of PERMISSION and DEMOGRAPHICS QUESTIONNAIRE

I, the undersigned, hereby give my permission to the researcher Brian Flanagan to include me in his study on Learning Styles. I voluntarily wish to participate in this study and understand that I may withdraw at any time. I give permission for the researcher to have access to my student records both at NAIT and the Apprenticeship Branch. Furthermore, I am assured that all information about me will be kept in the strictest of confidence and that everything reported will remain anonymous. My present employment and any position that I may hold in the future will not in any way be put at risk by this study.

signed_____Date_____

Address_____ (fill in address only if you want to see
_____ results of this study)
_____
_____

Telephone_____(home)_____(work)

Date of Birth_____

Student Number_____(Apprenticeship Number)

Type of Work (Estimate each by percentage of time spent)

Maintenance___Residential___Commercial___Industrial___

-Other(specify)_____

Size of Company-Small (less than 10 employees)_____

-Medium (11 to 50 employees) _____ (check one)

-Large (over 50 employees) _____

APPENBIX B

Characteristics of Field Dependent-Independent Learners

Table 1

Characteristics of Field Dependent-Independent Learners

	Field Dependent Learners	Field Independent Learners
Witkin et al., 1977a	• Warm, socially outgoing and sensitive people who are alert to social cues. • Favour activities which involve others and do not like to study or work alone. • Strongly influenced by others around them and are sensitive to criticism. • More likely to require externally defined goals and reinforcements and extrinsic forms of motivation. • May require more explicit instruction for problem-solving or more definitions of performance outcomes. • Make less use of mediational processes adopting a passive, spectator role in learning. • Are more dominated by salient cues in learning. • Better at learning and remembering information having a social relevance or content.	• Appear aloof, theoretical and not sensitive to others around them. • Prefer to work alone, avoid group interaction if given *the chance.* • Almost oblivious to social criticism. • Will restructure any random or non-hierarchically presented information for better retention and retrieval. • Tend to have self-defined goals and reinforcements. • May perform better when allowed to develop their own strategies for problem-solving. • Make greater use of analyzing and processing, adopting an active, hypothesis testing role in learning. • Are less dominated or governed by the most obvious or salient cues in learning.

(table continues)

	Field Dependent Learners	Field Independent Learners
Rosenberg, Mintz, & Clark. (1977)	• Tend to learn socially relevant material better than FIs. • Usually perform a spectator or passive learning role. • Are more affected than FIs by negative reinforcement. • Tend to be more influenced by the opinions of others or authority figures. • Possess lower "performance expectations". • Prefer discussions (i.e. interactive methods).	• Play a participant or active role in learning. • Learn more 'efficiently' in conditions of self-motivation. • Learn more effectively without performance feedback. • Do not seem to need an externally provided structure. • Are more attentive to "non-salient" attributes in concept learning tasks, and tend to favour lectures (i.e. expository methods).
Wehmeyer, 1984	• Global. • More easily distracted and confused by surroundings. • Tend to seek guidance and reassurance. • Enjoy socialization.	• Articulated. • Analytical. • Tend to be loners.

(table continues)

	Field Dependent Learners	Field Independent Learners
Wittrock, 1978	• FD people tend to perceive a pattern as a whole. • Have difficulty in focusing on one aspect of a situation or analyzing a pattern with different parts.	• Able to make finer discriminations than others in what they see. • Can isolate important elements from the surroundings or background, these people have good figure-ground perception. • FI people are more likely to perceive separate parts as a total pattern and be able to analyze a pattern according to its components.
Dixon (1977)	• FD people are more attentive to body language, facial expressions, and eye contact. • FD students are better at history, literature, social sciences and better at group work.	• More impersonal in their orientation. • Tend to be individualistic, competitive, sensitive to intrinsic motivational factors and more attentive to significant details.

APPENDIX C

Raw Data

Table 2

Raw Data

Student	GEFT score	Apprentice -ship exam	Age in Years	NAIT Exam	Hours to Completion
1	18	85	30	90	119
2	18	83	20	87	234
3	18	75	22	83	210
4	18	80	34	80	239
5	18	70	23	77	198
6	18	81	31	83	168
7	17	81	24	89	229
8	17	65	32	78	239
9	17	83	28	88	195
10	17	72	27	77	199
11	17	78	28	84	195
12	17	68	30	73	253
13	17	76	23	83	231
14	16	83	31	90	179
15	16	75	21	81	258
16	16	74	24	82	161
17	16	69	21	83	196
18	16	60	22	67	316
19	15	74	24	79	233
20	15	73	40	91	210
21	15	74	21	87	208
22	14	97	24	94	238
23	14	80	22	87	227
24	14	71	21	76	252
25	14	65	21	80	238
26	14	75	24	85	236
27	14	78	35	81	239

(table continues)

Student	GEFT score	Apprentice -ship exam	Age in Years	NAIT exam	Hours to completion
28	13	65	25	78	292
29	13	73	33	84	269
30	13	66	28	76	300
31	13	83	25	77	267
32	13	68	28	77	299
33	12	83	22	82	118
34	12	77	25	86	149
35	12	88	30	86	197
36	12	67	21	73	258
37	12	73	34	86	210
38	12	70	29	80	228
39	12	65	23	75	300
40	12	59	25	67	302
41	11	69	30	80	252
42	11	76	37	88	207
43	10	70	23	87	238
44	10	76	20	88	224
45	9	66	21	72	317
46	8	67	21	82	257
47	8	76	21	84	196
48	8	69	23	76	235
49	7	79	25	79	237
50	7	66	24	73	295
51	6	79	23	80	236
52	6	67	22	72	170
53	6	67	23	83	279
54	4	67	23	79	247
55	4	66	23	73	252
56	3	71	57	84	239
57	2	86	34	78	179
58	1	67	23	71	352